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# Stock Prices in the Presence of Liquidity Crises: The Effect of Creditor Protection

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We develop a model predicting two channels through which creditor protection affects stock prices: (1) the probability of a liquidity crisis leading to a binding investment-finance constraint falls with better creditor protection; (2) the stock prices under the investment-constrained regime increase with better creditor protection. We find evidence for both predictions using data on stock markets and creditor protection for 52 countries from 1980 to 2008. In particular, better creditor protection is correlated with lower stock market volatility and lower frequency of crises. Moreover, during crises, stock prices and investment fall more in countries with poor creditor protection.

## INTRODUCTION

A central problem in the credit market is that lenders are reluctant to make loans because they cannot easily determine whether a prospective borrower has resources to repay the loan. If the loan is made, the lender is concerned about whether the borrower will engage in risky behaviour that could lower the probability that the loan will be repaid. Collateral reduces this information asymmetry problem because high-quality collateral (that is, assets that are easily valued and easy to take control of) significantly decreases the losses to the lender if the borrower defaults on the loan. High-quality collateral also reduces the moral hazard problem because the borrower is reluctant to engage in excessively risky behaviour since now he or she has something to lose.[1] Creditor protection enhances the ability of the lender to take control of the collateral in case of default and thereby alleviate credit constraints. Thus creditor rights regulation helps to mitigate the problems of information asymmetry and moral hazard between creditors and borrowers. This mechanism is the focus of our paper.

Our analysis is motivated by two cross-country empirical regularities: first, that better creditor protection is associated with lower stock price volatility, and second, that countries with better creditor protection suffered lower declines in their stock market indexes during the current financial crisis.

Recent literature on law and finance has emphasized the role of strong institutions, such as those that enhance creditor protection, in fostering the development of financial markets. Accordingly, creditor rights protection affects the credit cycle and credit market breadth. For example, La Porta *et al.* (1997) find that countries with poor creditor protection have smaller debt markets. Their findings are confirmed by Levine (2004) as well as Djankov *et al.* (2006), with broader country coverage. Burger and Warnock (2007) also find that countries with stronger creditor rights have more developed local bond markets, and their economies rely less on foreign-currency bonds. Furthermore, Galindo and Micco (2005) find that strong creditor rights can reduce the volatility of the credit market. Creditor protection also lowers a firm's borrowing costs and increases the firm's value (e.g. La Porta *et al*. 2000; Bae and Goyal 2003); and it also reduces cash-flow risk, operating income variability, and operating leverage (e.g. Claessens *et al*. 2001). This literature focuses mainly on the credit market itself, not on the effect of creditor protection on the stock market.

In this paper, we attempt to fill a gap in the literature by addressing the issue of how the protection of creditor rights affects the level and volatility of stock prices.[2] We develop a Tobin's Q model of stock prices that demonstrates a mechanism through which creditor protection affects the level and volatility of stock prices.

In the empirical part of the paper, we analyse data of the aggregate stock prices in 52 developed and developing countries over the years 1980–2008. Liquidity crises are measured as a big decline in bank credit to the private sector, or a large rise in the real interest rate. We find that better creditor protection reduces the frequency of liquidity crises, as our model predicts, especially in the subsample of developing countries. We confirm this finding by estimating a probit regression controlling for a set of variables that also affect crisis probability, including a measure of shareholder rights protection.

Next we examine whether the liquidity crisis indicator has an effect on stock market prices. We find that negative excess returns during crises are much larger in countries with poor creditor rights protection, especially in developing countries. By conditioning on the crisis probability using propensity score matching, we find that in a matched sample, stock returns are lower during crises for countries with poor creditor rights protection but not for countries with good creditor rights protection.

The Tobin's Q model also predicts that the mechanism through which liquidity crises and credit constraints affect stock prices is their effects on investment. We find that the prediction of our model that investment will be less affected by liquidity crises in countries with stronger creditor rights protection is consistent with the data. Thus we provide strong empirical support for the mechanism developed in our model.

The remainder of the paper proceeds as follows. Section I contains a discussion of an empirical regularity. Section II develops the benchmark model of investment and stock prices in friction-free and credit-constrained regimes. Section III analyses the model in the presence of liquidity shocks, and presents the main findings of the analysis. Section IV demonstrates that these findings are consistent with the data. Section V concludes.

## I. Empirical Regularity

In this section we present an empirical regularity that serves to motivate the analysis in the following sections.

As a proxy for creditor protection, we use the creditor rights index (CRI) compiled by Djankov *et al*. (2007). This is a panel that covers 129 countries for 1978–2007. The CRI is constructed in the same way as in La Porta *et al*. (1998). It ranges from 0 to 4, with a higher number associated with better protection for creditors. The index is formed by adding one for each of the following four cases: when the country imposes restrictions, such as requiring a firm to obtain creditor consent or pay minimum dividends to file for reorganization; when secured creditors are able to gain possession of their security as soon as the reorganization petition has been approved (with no automatic stay); when secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and when the debtor does not retain the administration of its property pending the resolution of the reorganization. Appendix B, Table A1 shows 49 countries in our sample that fall into different categories of the CRI in 2007.

Our first piece of motivating evidence comes from the global financial crisis of 2008–9. As Table 1 shows, with the exception of the four countries with a credit rights index of 0, countries with better creditor protection experienced on average a lower decline in their stock price index in 2008. In particular, high levels of creditor protection, i.e. 3 or 4, are associated with lower decline in the stock market during the current crisis. Clearly, creditor protection may be correlated with many variables. Rose and Spiegel (2012), however, find that hardly any of the variables that one may consider explain cross-country differences in performance during the global financial crisis, making spurious correlation of the CRI and stock market performance during the crisis less likely.

Looking further back in history, we can see that better creditor protection is associated with lower stock index volatility. Table 2 presents such evidence for the full sample as well as for the subsamples of OECD and non-OECD countries. We combine levels of the CRI of 0, 1 and 2 into an indicator of a low level of creditor rights protection, and levels of the CRI of 3 and 4 into an indicator of a high level of creditor rights protection.

TABLE 1
AVERAGE CHANGE IN THE STOCK MARKET INDEX DURING THE CRISIS

| | During 2008 | | During 2008–9 | | |
|---|---|---|---|---|---|
| CRI | Mean | Median | Mean | Median | No. of countries |
| 0 | −38.9 | −36.0 | −6.4 | −5.2 | 4 |
| 1 | −48.5 | −50.4 | −33.8 | −26.1 | 14 |
| 2 | −52.3 | −51.5 | −29.1 | −34.0 | 11 |
| 3 | −44.3 | −47.3 | −18.0 | −24.1 | 11 |
| 4 | −39.0 | −37.4 | −15.2 | −15.8 | 6 |

*Notes*
We measure change in the stock market index from the close on the last trading day in 2007 to the close on the last trading day in 2008 or 2009.

TABLE 2
STOCK MARKET VOLATILITY AND CREDITOR PROTECTION

| | Full sample | Non-OECD | OECD |
|---|---|---|---|
| *Volatility of monthly stock returns* | | | |
| Mean low CRI | 8.149 | 10.15 | 6.627 |
| (No. of obs.) | (793) | (343) | (450) |
| Mean high CRI | 6.705 | 7.588 | 5.869 |
| (No. of obs.) | (471) | (229) | (242) |
| Difference | −1.445*** | −2.558*** | −0.758*** |
| ($p$-value) | (0.000) | (0.000) | (0.003) |
| *Volatility of annual stock returns* | | | |
| Mean low CRI | 39.52 | 50.05 | 32.09 |
| (No. of obs.) | (29) | (12) | (17) |
| Mean high CRI | 29.81 | 33.14 | 26.81 |
| (No. of obs.) | (19) | (9) | (10) |
| Difference | −9.719*** | −16.92*** | −5.286 |
| ($p$-value) | (0.004) | (0.0006) | (0.147) |

*Notes*
*** indicates significant at 1%.

We then test for statistical significance of the difference in stock market volatility depending on the level of creditor protection.

To measure stock price volatility, we use stock market indexes from Global Financial Data. We use monthly data calculated by central banks, national statistical agencies or stock exchanges themselves as of the end-of-month closes. We scale down all stock market indexes by the local consumer price index (CPI) at the end of the month. To measure the stock return volatility ($\sigma$), we compute non-overlapping standard deviations for the monthly stock returns for each calendar year.

The top panel of Table 2 is based on the panel evidence for our 49 countries for the years 1980–2007.[3] It shows strong evidence that in countries and years with a high index of creditor rights, stock market volatility is lower than in countries and years with a low index of creditor rights. One possible concern with this evidence is that the CRI, while available for a panel of countries, does not change much over time, thus exaggerating significance levels of the $t$-tests. Thus the bottom panel of Table 2 presents cross-country evidence with a stock market volatility measure based on annual observations over the sample period between 1980 and 2007, or as long as the data are available. Here we define an indicator of a high level of creditor protection as an average CRI for a given country being higher than 2.5. We classify countries that joined the OECD halfway through our sample period as non-OECD. We still find that stock market volatility is substantially higher in countries with a low level of creditor protection, although for the OECD subsample the significance level of the difference is only 14.7%, which is not surprising given the small sample size.

Thus we find that stock market volatility, historically, is higher in countries with a lower level of creditor protection. Moreover, we find that countries with a higher creditor protection level suffered lower declines in their stock market indexes during the current financial crisis. We now turn to the model that provides an explanation for this empirical regularity.

## II. A Tobin's $Q$ Model of Stock Prices and Investment

This section derives the analytical expression for the stock price by using the standard Tobin's Q model.[4]

Consider a small open economy facing a fixed world interest rate $r$. The production function of a representative firm is Cobb–Douglas:

$$Y_t = A_t K_t^{1-\rho}, \tag{1}$$

where $A_t$, $1-\rho$ and $K_t$ denote, respectively, the productivity shock parameter, the distributive share of capital, and the stock of capital. The productivity shock follows a first-order autoregressive stochastic process

$$\ln(A_{t+1}) = \gamma \ln(A_t) + \varepsilon_{t+1},$$

where $\varepsilon_{t+1}$ has a uniform distribution over $[-1,1]$. This stochastic process has both idiosyncratic and aggregate risk components.

The cost-of-adjustment investment technology for gross investment ($Z_t$) is quadratic:

$$Z_t = I_t\left(1 + \frac{1}{2}\frac{1}{v}\frac{I_t}{K_t}\right),$$

where $I_t = K_{t+1} - K_t$ denotes net capital formation, and $1/v$ is the cost-of-adjustment coefficient (the depreciation rate is assumed to be equal to zero). As usual, gross investment exceeds net capital formation because of additional reorganization and retraining costs associated with the installation of new capital.

We assume that a collateral is required by the creditors, which is a fraction $\omega$ of the existing capital stock. That is, $\omega K_t$ is a constraint on the amount of borrowing by the firm.[5] In addition to debt finance, we also assume an exogenously stochastic equity-finance process $W_t$.[6] A negative value of $W_t$ represents a systemic liquidity shock due to liquidation by shareholders, which leads to an investment-finance-constrained environment.

That is, the investment is constrained by

$$I_t \leq \omega K_t + W_t, \tag{2}$$

where a larger value of the creditor protection parameter $\omega$ is associated with a better creditor protection environment. We consider two regimes: a frictionless credit regime, and an investment-constrained regime.

*A frictionless regime*

For the frictionless regime, assume that equation (2) is not binding.

Risk-neutral producers maximize the expected value of the discounted sum of profits, subject to the production technology and the cost-of-adjustment investment technology. The Lagrangian of the optimization problem is

$$L_t = E_t\left[\sum_{s=1}^{\infty} \frac{1}{(1+r)^s}\left(A_t K_{t+s}^{1-\rho} - Z_{t+s} + Q_{t+s}(K_{t+s} + I_{t+s} - K_{t+s+1})\right)\right],$$

where the Lagrangian multiplier $Q_t$ is interpreted as the marginal Tobin's Q.

The first-order condition derived from the maximization of the Lagrangian with respect to $I_t$, is given by

$$1 + \frac{1}{v}\frac{I_t}{K_t} = Q_t. \tag{3}$$

The first-order condition associated with the derivative of the Lagrangian with respect to $K_{t+1}$ is given by

$$Q_t = \frac{1}{1+r}\left(E_t[R_{t+1}] + \frac{1}{2}\frac{1}{v}\left(\frac{I_{t+1}}{K_{t+1}}\right)^2 + E_t[Q_{t+1}]\right), \tag{4}$$

where $R_{t+1}$ denotes the period $t+1$ capital rental rate.

Competitive factor markets imply that

$$R_{t+1} = (1-\rho)A_{t+1}K_{t+1}^{-\rho}. \tag{5}$$

The investment rule in equation (4) combined with equations (3) and (5) states that the cost of investing an additional unit of capital in the current period must be equal to the expected present value of the next period rental value of capital, plus the next period decline in adjustment costs of investment, plus the continuation marginal value of next-period capital.

Let $\widetilde{L}_t$, the capitalization value of the firm, be the maximized value of $L_t$, which will be our theoretical counterpart of the empirical stock price index (see Gomes 2001). Recall that with a quadratic cost-of-adjustment function, the average Tobin's Q is equal to the marginal Q.[7] Then

$$\widetilde{L}_t = Q_t K_{t+1}.$$

We now log-linearize the model around the deterministic steady state given by

$$\text{(6)} \qquad \bar{A} = 1, \bar{K} = \left(\frac{1-\rho}{r}\right)^{1/\rho} \quad \text{and} \quad \bar{Q} = 1, \ \bar{W} = 0.$$

The log-linearized equations (3) and (5) around the deterministic steady state yield an approximate expression for $Q_t$:[8]

$$\text{(7)} \qquad Q_t = \frac{(1-\rho)(1+\rho \ln \bar{K} + \gamma a_t + \rho(v - k_t))\bar{K} + E_t[Q_{t+1}]}{1 + r + v\rho(1-\rho)\bar{K}},$$

where $a_t = \ln(A_t)$ and $k_t = \ln(K_t)$.

The equilibrium level of $Q_t$ is a linear combination of the state variables $a_t$ and $k_t$:

$$\text{(8)} \qquad Q_t = B_0 + B_1 a_t + B_2 k_t.$$

Substituting equation (8) into equation (7), we solve for $B_0$, $B_1$ and $B_2$ by comparing coefficients for $a_t$ and $k_t$:

$$\text{(9)} \qquad B_0 = \frac{(1-\rho)(1 + v\rho + \rho \ln \bar{K})\bar{K} - vB_2}{r + v\rho(1-\rho)\bar{K} - vB_2},$$

$$\text{(10)} \qquad B_1 = \frac{\gamma(1-\rho)\bar{K}}{1 + r - \gamma - vB_2 + v(1-\rho)\rho\bar{K}},$$

$$\text{(11)} \qquad B_2 = \frac{(Kv\rho - Kv\rho^2 + r) - \sqrt{(Kv\rho - Kv\rho^2 + r)^2 + 4v(K\rho - K\rho^2)}}{2v}.$$

Based on equations (3) and (9)–(11), the frictionless equilibrium investment level is given by

$$\text{(12)} \qquad I_{t0} = vK_t(B_0 + B_1 a_t + B_2 k_t - 1).$$

Equation (12) implies that in the unconstrained regime, investment increases if productivity rises (i.e. $B_1 > 0$), and investment falls if the stock of capital increases (i.e. $B_2 < 0$), as expected.

*The investment-finance-constrained regime*

Now assume that equation (2) is binding.

For simplicity, we assume that after a negative realization of $W_t$, no future shocks are anticipated. That is, on the realization in period $t$ of the liquidity shock, the investment-finance constraint becomes binding in all present and future periods: $t, t+1, \ldots, \infty$. Thus we assume that

$$I_s = \omega K_s + W_s \text{ for all } s \geq t.$$

*Derivation of the investment-finance-constrained Tobin's Q*

The capitalization value $L_t$ of the firm at the end of period $t$ is given by

$$\hat{L}_t = \max_{I_t, K_t} E_t \left[ \sum_{s=1}^{\infty} \frac{1}{(1+r)^s} \left( A_{t+s} K_{t+s}^{1-\rho} - Z_{t+s} \right) \right]. \tag{13}$$

The average Tobin's Q, at the end of period $t$, is

$$\begin{aligned} Q_t &= \frac{\hat{L}_t}{K_{t+1}} \\ &= \frac{1}{1+r} E_t \left( A_{t+1} K_{t+1}^{-\rho} - \frac{Z_{t+1}}{K_{t+1}} + \frac{K_{t+2}}{(1+r) K_{t+1}} Q_{t+1} \right). \end{aligned} \tag{14}$$

Because the finance constraint is binding, we also have

$$K_{t+s+1} = (1+\omega) K_{t+s} + W_t, \quad \text{for all} \quad s = 0, 1, 2, \ldots. \tag{15}$$

Using equations (13), (14) and (15), we write the Tobin's Q equation (expressed as a difference equation) as follows:[9]

$$\hat{Q}_t = \frac{1}{1+r} E_t \left( A_{t+1} K_{t+1}^{-\rho} - \omega \left( 1 + \frac{\omega}{2v} \right) + \frac{1+\omega}{1+r} \hat{Q}_{t+1} \right). \tag{16}$$

Log-linearizing equation (16) around the deterministic steady state (see equations (6)), we get

$$\hat{Q}_t = \frac{1}{1+r} E_t \left( \bar{K} (1 + \rho \ln(\bar{K}) + a_{t+1} - \rho k_{t+1}) - \omega \left( 1 + \frac{\omega}{2v} \right) + \frac{1+\omega}{1+r} \hat{Q}_{t+1} \right). \tag{17}$$

We can now solve for $\hat{Q}_t$, by 'guessing' the linear equilibrium relationship between $\hat{Q}_t$ and the state variables $a_t$ and $k_t$:

$$\hat{Q}_t = C_0 + C_1 a_t + C_2 k_t. \tag{18}$$

The 'guess' is verified by the substitution of equation (18) into equation (17), to get

$$C_0 = \frac{(1+r)\Big(\bar{K}(\rho\ln\bar{K} - \rho\ln(\omega+1)+1) - \omega\big(\frac{1}{2\nu}\omega+1\big) - \bar{K}\rho(\ln(\omega+1))\frac{\omega+1}{r^2+2r-\omega}\Big)}{r^2+2r-\omega},$$

$$C_1 = \frac{\gamma(1+r)\bar{K}}{1-\gamma-\gamma\omega+2r+r^2},$$

$$C_2 = -\frac{\rho(1+r)\bar{K}}{r^2+2r-\omega}.$$

As in the frictionless case, the above equations imply that Tobin's Q increases if productivity rises i.e. $C_1 > 0$). The sign of $C_2$, however, depends on the relative values of $r$ and $\omega$.

## III. Effects of Liquidity Crises and Creditor Protection

We can now use the above results to derive the relationship between creditor protection and stock price level and volatility in the presence of liquidity crises. We define $\widetilde{L}_{t,\text{unconstrained}}$ as the firm capitalization value in the frictionless case, and $\widetilde{L}_{t,\text{constrained}}$ as the capitalization value in the investment-finance constraint case.

### *The effect of liquidity crises on the stock price index*

We are now in a position to derive the expression for the expected returns in the stock market as a function of the probability of a liquidity crisis. Let $U_t$ be an indicator for the finance-constrained regime. That is, $U_t = 1$ when the investment-finance constraint binds, and $U_t = 0$ when the constraint does not bind. The expected value of the stock price index is

$$E_t[\widetilde{L}_t; a_t, k_t, \omega] = \Pr(U_t = 0)\widetilde{L}_{t,\text{unconstrained}} + \Pr(U_t = 1)\widetilde{L}_{t,\text{constrained}}.$$

The probability of a credit crunch is given by

$$\Pr(U_t = 1) = \Pr(I_{t0} > \omega K_t + W_t).$$

Recall that $I_{t0}$ is the equilibrium investment in the frictionless case.

Note that

$$\frac{\partial E_t[\widetilde{L}_t; a_t, k_t, \omega]}{\partial\omega} = \frac{\partial \Pr(U_t = 0)}{\partial\omega}[\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}}] + \frac{\partial(\widetilde{L}_{t,\text{constrained}})}{\partial\omega}(1 - \Pr(U_t = 0)).$$

We can now state the following proposition.

*Proposition 1.* If the creditor protection becomes stronger ($\omega$ increases), the expected stock price index rises through two channels: (1) the probability of a liquidity crisis diminishes; (2) the capitalization value of the firm rises in the investment-finance-constrained regime.

To prove this proposition, note the following.

(i) We have

$$\frac{\partial \Pr(U_t = 0)}{\partial \omega} > 0,$$

because the expression $\Pr(I_{t0} > \omega K_t - W_t)$ depends negatively on $\omega$.

(ii) Lifting the constraint must raise the value function if the credit constraint binds. Therefore

$$\frac{\partial(\widetilde{L}_{t,\text{constrained}})}{\partial \omega} > 0.$$

(iii) In general, the value function in the constrained regime cannot exceed the value function in the unconstrained regime. This implies that

$$\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}} > 0.$$

Hence creditor protection enhances average stock returns.

We can also formulate the following corollary.

*Corollary 1.* If the creditor protection becomes stronger ($\omega$ increases), the expected investment rises through two channels: (1) the probability of a liquidity crisis diminishes; (2) the investment of the firm rises in the investment-finance-constrained regime.

*The effect of liquidity crises on the variance of the stock price index*

By the variance decomposition rule, we have

$$\text{(19)} \qquad \text{Var}[\widetilde{L}_t] = E_t[\text{Var}[\widetilde{L}_t | U_t]] + \text{Var}[E_t[\widetilde{L}_t | U_t]],$$

where $\text{Var}[\widetilde{L}_t]$ is the variance of $\widetilde{L}_t$.

The first term on the right-hand side of equation (19) is given by

$$\begin{aligned} E_t[\text{Var}[\widetilde{L}_t | U_t]] = &\Pr(U_t = 0)\text{Var}[\widetilde{L}_{t,\text{unconstrained}} | U_t = 0] \\ &+ \Pr(U_t = 1)\text{Var}[\widetilde{L}_{t,\text{constrained}} | U_t = 1]. \end{aligned}$$

Combining equations (8) and (18), we get

$$E_t[\text{Var}[\widetilde{L}_t | U_t]] = \left(\Pr(U_t = 0)B_1^2 + \Pr(U_t = 1)C_1^2\right)\text{Var}[\varepsilon_t]$$

and

$$\text{Var}[E_t[\widetilde{L}_t | U_t]] = \Pr(U_t = 1)(1 - \Pr(U_t = 1))(\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}})^2,$$

where Var $[\varepsilon_t]$ denotes the variance of the productivity shock.

To focus on the effect of liquidity shocks, it is useful to shut off the productivity shock (i.e. $\mathrm{Var}[\varepsilon_t] = 0$).[10] In this case,

$$\begin{aligned}\mathrm{Var}[\widetilde{L}_t] &= \mathrm{Var}[E_t[\widetilde{L}_t|U_t]] \\ &= \Pr(U_t = 1)(1 - \Pr(U_t = 1))(\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}})^2.\end{aligned}$$

The effect of $\omega$ on the variance is

$$\begin{aligned}\frac{\partial \mathrm{Var}[\widetilde{L}_t]}{\partial \omega} &= (1 - 2\Pr(U_t = 1))(\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}})^2 \frac{\partial \Pr(U_t = 1)}{\partial \omega} \\ &\quad + \Pr(U_t = 1)(1 - \Pr(U_t = 1)) \frac{\partial(\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}})^2}{\partial \omega}.\end{aligned}$$

From the preceding subsection, recall that

$$\frac{\partial \Pr(U_t = 1)}{\partial \omega} < 0.$$

Also, as shown above, we have

$$\frac{\partial(\widetilde{L}_{t,\text{unconstrained}} - \widetilde{L}_{t,\text{constrained}})^2}{\partial \omega} < 0.$$

Therefore

$$\frac{\partial \mathrm{Var}[\widetilde{L}_t]}{\partial \omega} < 0.$$

This result is stated as a proposition.

*Proposition 2*. If the creditor protection becomes stronger, the variance of stock price index declines through two channels: (1) the difference between the stock prices in the constrained regime and the unconstrained regime decreases; (2) the probability of credit crunches declines.

Hence better creditor protection reduces the volatility of the stock market.

## IV. Empirical Evidence

We turn now to confront the main predictions of the model, in Propositions 1 and 2, with cross-country data. To do that, we use the index of creditor rights protection described above. We note that institutions of shareholder protections, such as antidirectors' rights, could affect the stochastic process $W_t$, so a greater protection of shareholder rights makes liquidity crises less likely.[11] We test this latter implication using an index of shareholder rights, described below.

The empirical regularity presented in Section I, i.e. the fact that countries with a higher level of creditor protection experienced less of a decline in the stock market index during the current financial crisis, is indeed consistent with the predictions of our model. We want to make sure, however, that there is also historical evidence to support the mechanisms described in our model. In particular, our model predicts that: (1) the incidence of financial crises should be lower in countries with better creditor protection; (2) the decline in the stock market index during crises should be lower in countries with better creditor protection.

We define a liquidity crisis as a union of two sets of events: a sharp decline in bank credit to the private sector, and a sharp increase in the real interest rate. In both cases we define observations in the top 10% tail of annual changes in the underlying variable as crises. These correspond to the annual decline of credit to the private sector by 10% and to an increase in the real interest rate of over 4.3 percentage points in one year.[12] Thus our liquidity crisis variable measures domestic liquidity crises and proxies for periods when credit constraints are likely to be binding.[13] Crisis episodes that we define in this way are listed in Appendix B, Table A2.

The top panel of Table 3 shows the relationship between the frequency of liquidity crises, as defined above, and the level of creditor rights protection. We find that on average, countries with lower level of creditor rights protection tend to have more frequent crises, consistent with the first of the two main model predictions. These differences are driven by the sample of non-OECD countries—for them, frequency of crises is twice as high if they have low creditor rights protection. If a non-OECD country has good creditor rights protection, we find that it has the same frequency of liquidity crises as an average OECD country.

The bottom panel of Table 3 shows the relationship between the CRI and the decline in stock market return during crisis years compared to the stock market return in non-crisis years. This 'excess return' during crisis years is defined as a difference between median returns in crisis and non-crisis years for each country. To measure stock returns, we use monthly data calculated by central banks, national statistical agencies or stock exchanges

TABLE 3
FREQUENCY OF LIQUIDITY CRISES, STOCK RETURNS AND CREDITOR PROTECTION

| | Full sample | Non-OECD | OECD |
|---|---|---|---|
| *Incidence of liquidity crises* | | | |
| Mean low CRI | 0.22 | 0.30 | 0.15 |
| (No. of obs.) | (779) | (362) | (417) |
| Mean high CRI | 0.16 | 0.16 | 0.16 |
| (No. of obs.) | (445) | (226) | (219) |
| Difference | −0.062*** | −0.15*** | 0.008 |
| (*p*-value) | (0.006) | (0.00) | (0.77) |
| *Difference in median returns* (*crisis – non-crisis*) | | | |
| Mean low CRI | −0.55 | −0.88 | −0.31 |
| (No. of obs.) | (29) | (12) | (17) |
| Mean high CRI | −0.18 | −0.088 | −0.27 |
| (No. of obs.) | (20) | (10) | (10) |
| Difference | 0.37* | 0.79* | 0.039 |
| (*p*-value) | (0.077) | (0.088) | (0.81) |

*Notes*
*, *** indicate significant at 10%, 1%, respectively.

themselves as of the end-of-month closes. We scale down all stock market indexes by the local CPI at the end of the month. To measure stock market level, we average the scaled down index for each country for each calendar year.

We can see that the decline in stock market return is larger during crisis for countries with lower creditor rights protection, which is exactly what our model predicts. The differences are statistically significant, except for the OECD sample. Thus we find that the data are consistent with the second mechanism predicted by our model.

To push further our empirical tests of the mechanism presented in our model, we estimate a probit regression of our liquidity crisis indicator on the indicator of high creditor protection and its interaction with the OECD dummy. Our control variables include a lagged dependent variable, the ICRG political stability index, the growth rate of GDP per capita, and a *de jure* measure of capital controls. We also control for a measure of the shareholder protection index (SPI), because we expect it to have a negative effect on the probability of a liquidity crisis.[14] The results are reported in the first column of panel A of Table 4. We confirm that liquidity crises are less frequent in countries with a higher level of creditor protection, but only in the sample of non-OECD countries. In terms of magnitude of the effects, an increase in the CRI from a low level of 0, 1 or 2 to a high level of 3 or 4 lowers the probability of a liquidity crisis in a non-OECD country by 10 percentage points.

The second and third columns of panel A report the results of the regression analysis conducted separately for the high creditor protection countries and low creditor protection countries. Consistent with our intuition, we find that crises are persistent and that better political stability, higher GDP growth, and capital controls all lower the probability of a liquidity crisis. We also find that among countries with high levels of creditor rights protection, crises are less likely in countries with better shareholder rights. Once these controls are in place, we find no difference in this conditional crisis probability between OECD and non-OECD countries.

Because creditor rights protection affects the probability of the crisis, and yet we want to compare the stock market return and volatility during the crises, we undertake a propensity score matching exercise. Using the estimates of the probit regressions described above, we construct the propensity score and match crisis observations (treatment group) to non-crisis observations (control group) using Epanechnikov kernel matching. We limit the matched observations to common support. We then compute the average treatment effect on treated (ATT), using the matched sample, for stock market return and volatility.

The results of the matching exercise are reported in panels B and C of Table 4. The first column reports benchmark results for the full sample of countries. We find that in the matched sample, the stock market return is only half as high during a crisis, although the difference between crisis and non-crisis stock return is not statistically significant. We also find that in a matched sample, the stock return volatility is substantially higher during a crisis, and the differences are statistically significant.

Our main goal, however, is to test whether these differences between crisis and non-crisis stock returns are higher for countries with a low level of creditor rights protection. To this end, we repeat the matching exercise for the subsamples of countries with high and low levels of creditor rights indicators. We find that for countries with good creditor rights protection, there is absolutely no difference in matched or unmatched samples, between stock returns during crisis episodes and during normal times. For countries with low creditor rights indicators, however, we find for the matched sample that stock market returns are three times lower during the crises, and the differences between stock returns

TABLE 4
EFFECTS OF LIQUIDITY CRISES ON STOCK INDEX LEVEL AND VOLATILITY: PROPENSITY SCORE MATCHING AND AVERAGE TREATMENT EFFECT

| | Full sample | High CRI | Low CRI |
|---|---|---|---|
| *Panel A: Marginal effects from probit regressions* | | | |
| High CRI | −0.10*** | | |
| | (0.035) | | |
| High CRI * OECD | 0.13* | | |
| | (0.077) | | |
| SPI | −0.005 | −0.039* | 0.015 |
| | (0.015) | (0.022) | (0.021) |
| OECD | −0.040 | 0.004 | 0.011 |
| | (0.043) | (0.062) | (0.050) |
| Lag(crisis) | 0.14*** | 0.097 | 0.15*** |
| | (0.039) | (0.062) | (0.049) |
| Political stability | −0.002 | −0.0002 | −0.004* |
| | (0.001) | (0.002) | (0.002) |
| Real GDP growth | −0.007 | 0.017 | −0.028** |
| | (0.009) | (0.012) | (0.013) |
| Capital controls | −0.001 | −0.001 | −0.002 |
| | (0.0008) | (0.001) | (0.001) |
| Observations | 869 | 326 | 543 |
| Pseudo $R^2$ | 0.064 | 0.028 | 0.088 |
| *Panel B: Mean real annual stock return* | | | |
| *Unmatched* | | | |
| Crisis | 0.39 | 0.35 | 0.42 |
| No crisis | 0.66 | 0.33 | 0.87 |
| Difference | −0.27 | 0.023 | −0.46 |
| ($p$-value) | 0.34 | 0.96 | 0.18 |
| *Matched (ATT)* | | | |
| Crisis | 0.40 | 0.35 | 0.42 |
| No crisis | 0.84 | 0.52 | 1.22 |
| Difference | −0.44 | −0.17 | −0.81* |
| ($p$-value) | 0.22 | 0.75 | 0.08 |
| *Panel C: S.D. of real monthly stock return* | | | |
| *Unmatched* | | | |
| Crisis | 10.5 | 9.32 | 11.0 |
| No crisis | 7.56 | 7.27 | 7.74 |
| Difference | 2.91*** | 2.05*** | 3.26*** |
| ($p$-value) | 0.00 | 0.002 | 0.00 |
| *Matched (ATT)* | | | |
| Crisis | 10.5 | 9.32 | 11.0 |
| No crisis | 8.94 | 7.43 | 9.80 |
| Difference | 1.55** | 1.89** | 1.19 |
| ($p$-value) | 0.01 | 0.03 | 0.14 |

*Notes*
*, **, *** indicate significant at 10%, 5%, 1%, respectively.

TABLE 5
EFFECTS OF LIQUIDITY CRISES ON INVESTMENT: AVERAGE TREATMENT EFFECTS

| Real investment growth rate | Full sample | High CRI | Low CRI |
|---|---|---|---|
| *Unmatched* | | | |
| Crisis | 2.63 | 3.73 | 2.21 |
| No crisis | 4.28 | 4.27 | 4.28 |
| Difference | −1.64 | −0.54 | −2.06* |
| *p*-value | 0.11 | 0.77 | 0.10 |
| *Matched (ATT)* | | | |
| Crisis | 2.75 | 3.67 | 2.21 |
| No crisis | 4.99 | 4.83 | 4.95 |
| Difference | −2.23 | −1.16 | −2.74 |
| *p*-value | 0.11 | 0.62 | 0.105 |

*Notes*
* indicates significant at 10%.

in crises and normal times are statistically significant. This test therefore provides strong support for the mechanism highlighted in our model.

Even though our model does not have direct predictions on the relative volatility of stock returns in crisis and in normal times, we find that for both samples of countries, stock market volatility is higher during crises. This finding is consistent with our intuition and with the spirit of our model.

The main mechanism through which creditor protection and liquidity crises affect stock prices in our model is through their effect on investment. The model implies that the adverse effect of a liquidity crisis on investment is mitigated by a high level of creditor protection, as stated in part (2) of the Corollary to Proposition 1. We test this implication in a manner similar to the arguments for the ones associated with stock price index, comparing the average investment growth, during crisis and non-crisis years, for countries with weak and strong creditor rights protection. We use the results of our probit estimation in Table 4 to construct matched samples.

The results are reported in Table 5. We find that in both full and matched samples, the decline in investment growth rate during liquidity crises is small and not statistically significant in countries with strong creditor rights protection. However, in countries with weak creditor rights protection, we find that the investment growth rate declines by a factor of 2 during the crises, with a difference that is statistically significant in the full sample. This difference, however, is only borderline significant in the matched sample. In fact, investment growth during non-crisis periods is similar across subsamples, while investment growth during crisis periods is substantially lower in countries with weak creditor rights protection.

## V. CONCLUSION

In this paper we examine the effect of creditor rights protection on the behaviour of stock prices in the presence of liquidity crises. We develop a Tobin's Q model, which predicts that strengthening of the creditor rights protection results in higher expected returns and reduced volatility of stock price indexes, as well as higher expected investment.

Analysing the data for 52 developed and developing countries over the period 1980–2008, we find support for the predictions of the model as well as evidence consistent with the mechanism through which creditor protection affects stock market returns. Specifically, we find support for the three main testable implications of the model: higher frequency of crises, larger change in stock market returns during crises, and larger decline in investment during crises in countries with poor creditor rights protection.

## APPENDIX A: DERIVATION OF STOCK PRICE UNDER A FRICTION-FREE REGIME

The first-order condition derived from the maximization of the Lagrangian with respect to $I_t$ is given by

$$1 + \frac{1}{v}\frac{I_t}{K_t} = Q_t.$$

Linearizing $\ln\,(1 + \upsilon(Q_t - 1))$ at the steady state $\bar{Q} = 1$ yields

$$k_{t+1} = k_t + v(Q_t - 1). \quad \text{(A1)}$$

Linearizing $R_{t+1}$ at the steady state, $\bar{A}$ and $\bar{K}$, gives

$$R_{t+1} = (1-\rho)\bar{K}(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}).$$

Also,

$$\frac{1}{v}\left(\frac{I_{t+1}}{K_{t+1}}\right)^2 = v(Q_{t+1} - 1)^2,$$

hence

$$Q_t = \frac{1}{1+r}E_t[(1-\rho)\bar{K}(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}) + \frac{1}{2}v(Q_{t+1} - 1)^2 + Q_{t+1}]. \quad \text{(A2)}$$

Around the steady state, $(Q_{t+1} - 1)^2$ is an order of magnitude smaller than the term $(Q_{t+1} - 1)$. Accordingly, we drop $(Q_{t+1} - 1)^2$ from the approximation equation (A2), and get

$$(1+r)Q_t = (1-\rho)\bar{K}(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}) + E_t[Q_{t+1}].$$

Note that

$$a_{t+1} = \gamma a_t + \varepsilon_{t+1}. \quad \text{(A3)}$$

Combining equations (A1), (A2) and (A3), we get

$$Q_t = \frac{(1-\rho)\big(1 + \rho \ln \bar{K} + \gamma a_t + \rho(v - k_t)\big)\bar{K} + E_t[Q_{t+1}]}{1 + r + v\rho(1-\rho)\bar{K}}.$$

## APPENDIX B: ADDITIONAL TABLES

TABLE A1
CREDITOR RIGHTS INDEX AS OF 2007

| Low creditor rights index | High creditor rights index |
|---|---|
| *Creditor rights index* = 0 | *Creditor rights index* = 3 |
| Mexico | Singapore |
| Colombia | Austria |
| France | Venezuela |
| Peru | Malaysia |
| | Germany |
| *Creditor rights index* = 1 | Korea |
| Greece | Denmark |
| Ireland | Slovenia |
| Portugal | Israel |
| Brazil | Australia |
| Canada | South Africa |
| Argentina | Netherlands |
| Pakistan | Czech Republic |
| Poland | |
| Philippines | *Creditor rights index* = 4 |
| Hungary | United Kingdom |
| United States | Hong Kong |
| Switzerland | New Zealand |
| Sweden | |
| Finland | |
| *Creditor rights index* = 2 | |
| Italy | |
| Sri Lanka | |
| Norway | |
| Russia | |
| Romania | |
| Indonesia | |
| Chile | |
| Turkey | |
| China | |
| Thailand | |
| India | |
| Spain | |
| Japan | |
| Bulgaria | |
| Belgium | |

TABLE A2
LIST OF LIQUIDITY CRISES IN THE SAMPLE

| Country | Years of financial crisis |
| --- | --- |
| *Non-OECD countries* | |
| Argentina | 1982–5, 1990–1, 1994, 2001–4 |
| Brazil | 1982, 1985–7, 1989–90, 1994–5, 1997–8 |
| Bulgaria | 1992–5, 1997, 2005 |
| Chile | 1981, 1983–6, 1988, 1991, 1996, 1998, 2005 |
| China | 1988, 1994, 1997, 2007 |
| Colombia | 1988, 1991, 1994, 1999–2000 |
| Cyprus | 1991, 1993, 1995, 1998 |
| Hong Kong | 1991, 1999 |
| Hungary | 1984, 1988, 1991–3, 1995 |
| India | 1989, 1991, 1995 |
| Indonesia | 1998–9 |
| Israel | 1981, 1985–6, 1995, 1999, 2006 |
| Korea | 1983, 1992 |
| Malaysia | 1987, 1990, 2000 |
| Mexico | 1982–3, 1988 |
| Pakistan | 1984, 1999–2000 |
| Peru | 1984–7, 1989, 1991, 2000–1, 2003–4, 2006 |
| Philippines | 1984–6, 1990, 1998–2001, 2005, 2007 |
| Poland | 1982–4, 1987–90, 1992, 1994–5, 1997 |
| Romania | 1991, 1997, 1999–2000 |
| Singapore | 1990, 1995, 2002, 2004, 2007 |
| Slovenia | 1992, 2007 |
| South Africa | 1983, 1992, 2002 |
| Sri Lanka | 1982, 1984–5, 1989, 1991, 1994, 2002 |
| Thailand | 1982, 1984, 1999–2001 |
| Venezuela | 1984, 1986, 1989–90, 1993–4, 2002–3 |
| *OECD countries* | |
| Australia | 1981, 1984, 1997, 2001, 2003 |
| Austria | 1986 |
| Belgium | 1986 |
| Canada | 1992, 1994, 2007 |
| Czech Republic | 1998–2002, 2007 |
| Denmark | 1982, 1990–1, 1993–4, 2006 |
| Finland | 1990, 1993–5, 1997–8 |
| France | 2005 |
| Germany | 1998, 2006 |
| Ireland | 1986 |
| Italy | 1986, 1991–2, 1996, 2005–6 |
| Japan | 1982, 1985, 1991, 1999, 2001 |
| Luxembourg | 1983, 1985, 1995, 2002 |
| Mexico | 1995–6, 1998–2001, 2003 |
| Netherlands | 1981, 1983, 1986, 2006 |
| New Zealand | 1982, 1984, 1988, 1999 |
| Norway | 1991, 1998 |
| Portugal | 1985–7, 1991 |

TABLE A2
CONTINUED

| Country | Years of financial crisis |
|---|---|
| Spain | 1984, 1987, 2002 |
| Sweden | 1984, 1991–5, 2000, 2004 |
| Switzerland | 1986, 1994 |
| Turkey | 1986, 1988–9, 1994, 1997–8, 2001 |
| UK | 1982, 2001 |
| USA | 1993–4, 2006 |


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## NOTES

1. For a review of theories relating moral hazard and adverse selection to banking crises, credit frictions and market freezes, see Goldstein and Razin (2013).
2. Some studies have examined how corporate control affects the dispersion of stock prices within a market. For example, Morck *et al*. (2000) look at the stock price comovement within a country. They find that comovement is more pronounced in poor economies than in rich economies, which they attribute to cross-country differences in property rights. Our work is concerned not with the idiosyncratic dispersion of stock prices, but rather with the instability in the aggregate. Albuquerque and Wang (2008) examine how the separation of ownership and control allows controlling shareholders to pursue private benefits and thus affects the volatility of stock prices. They study the effects of shareholder rights, while we study the effects of creditor rights.
3. We exclude 2008 in order not to capture the effect of the recent crisis.
4. For a similar model of stock prices, see Krugman (1998) and Frenkel and Razin (1996, ch. 7).
5. Similar to Mendoza (2006a, b, 2010).
6. We do not endogenize the debt–equity finance decisions, as in models of information asym-metry by Myers (1984) and Myers and Majluf (1984), or of limited enforcement of financial contracts by Bernanke and Ger-tler (1989) and Kiyotaki and Moore (1997). See also Gomes (2001) for the model of tax differences between equity and debt financing in which the compo- sition of the firm finance is uniquely determined, contrary to the Modigliani–Miller theorem.
7. See Hayashi (1982) for the equality between average $Q$ and marginal $Q$.
8. See Appendix A.
9 To simplify the exposition, we calibrate the realized value of $W_t$ that triggers the finance constraint to zero.
10. If $\mathrm{Var}[\varepsilon_t]$ is not equal to 0, then we can see that as $w$ rises, $C_1$ will increase, and hence the volatility of $P_t$ will also increase in reaction to a shock to the technology $a_t$. That is, when the constraint always binds, weak creditor protection will reduce the stock price volatility. The intuition is that a binding credit constraint would reduce the upside potential of good productivity shocks by constraining firm growth.
11. Albuquerque and Wang (2008) find that lower shareholder protection increases volatility of stock price.
12. We obtain the data on interest rates from IMF International Financial Statistics. We use line 22d for the bank credit to private sector and divide it by the CPI. For the interest rate, in most cases we use the money market rate. When the money market rate is not available, we use the discount rate. We calculate the real interest rate by subtracting the CPI inflation rate from the nominal interest rate. We then calculate annual percentage changes in these variables to identify liquidity crisis episodes.

13. Note that because we are interested in not only the onset of the crisis, but also the crisis *situation*, we keep our indicator equal to 1 in all the years that our procedure determines as crises, not only in the first crisis year.
14. Better shareholder protection can lower the volatility of equity financing, thus lowering the probability of a liquidity crisis in our model. We use as a proxy for the shareholder protection index the revised antidirectors' rights index constructed by Djankov *et al*. (2008) and discussed by Spamann (2010). It measures legal protection of minority shareholders against expropriation by corporate insiders.

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